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Management of Biodiversity and Conservation of Genetic Resources for Food and Agriculture in Peru

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Abstract

Peru has high ecological diversity, diverse climates, extensive ecological zones, large production areas, and highly productive ecosystems, which have supported high biodiversity, leading it to be recognized as a mega-diverse country and one of the world's most important centers for plant and animal genetic resources. Also associated with this biodiversity is high cultural diversity.

Laws of international, regional, and national scope have been ratified and/or enacted in Peru, for the purpose of promoting conservation, sustainable use, and access to genetic resources under an ecosystem approach. In addition, laws have been enacted to protect the collective knowledge of indigenous people linked to biological resources, and also to ensure that the use of biotechnology does not harm biodiversity or the environment.

The National System of Protected Natural Areas of the Peruvian State is the main *in situ* conservation system of biological diversity; currently it includes 63 protected areas which represent 14.80% of the total area of the country. In addition, there are many plant and animal germplasm banks in which 54,351 accessions are conserved *ex situ* under medium- to long-term storage conditions.

In situ conservation of plant genetic resources has been practiced since ancestral times by local farmers, especially in the Andean region. Since the beginning of the 1990s, many projects of *in situ* conservation have been executed in different regions of the coast, mountains, and jungle, with the objective of studying the dynamics of this type of conservation, establish biodiversity microgenecenters, conduct seed fairs, and develop records of

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traditional varieties and their wild relatives and of conservationist farmers' practices. Peasant communities, together with non-governmental organizations (NGOs) and regional governments, are promoting the recognition of geographical areas so that the resources there can be properly managed, including the components of biodiversity and genetic resources.

The Subdirection of Genetic Resources and Biotechnology of the National Institute of Agricultural Innovation has developed an information system (currently in the test phase) for managing information of its germplasm bank, and it also has been considered for inclusion in implementing the GRIN GLOBAL information system of genetic resources.

A complete system for managing genetic resources for food and agriculture must include the conservation of genetic resources (both *ex situ* and *in situ* conservation), the development of infrastructure for conservation, especially for the long term, and the development of human capabilities and information systems.

Peruvian biodiversity

Peru is located in the central and occidental part of South America, with a continental extension of 1,285,216 km^2, with 136,233km² (10.6%) in the coastal region, 404,843 km² (31.5%) in the Andean region, and 754,140 km² (57.9%) in the Amazonian region. It encompasses 25 political regions.

It has high ecological diversity, diverse climates, varied ecological zones, large production areas, and highly productive ecosystems[2]. All these have supported elevated biological diversity (biodiversity), and Peru is recognized as a mega-diverse country. In addition, it is the center of origin of many important crops and breeds, and also wild relatives of domesticated species. In consequence, it is one of the world’s most important centers for plant and animal genetic resources. This biodiversity has also spurred high cultural diversity, expressed in 70 ethno-linguistic groups with large experience in conservation and sustainable use of genetic resources, especially crops and plants for medicinal uses in the Amazonian and Andean regions.

There are 128 species of native plants domesticated with hundreds or even thousands of varieties, and also wild forms of these plants. For instance, there are nine domesticated species of potato with 4000 varieties and 85 wild species; and there are 15 species of tomatoes. In terms of fauna, there are five domesticated animals: the alpaca, a domesticated

[2] Brack E., A. 2000. Peru a wonderful country.

form of the vicugna (*Lama vicugna*); the llama, a domesticated form of the guanaco (*Lama guanicoe*); the guinea pig, a domesticated form of the poronccoy (*Cavia tschudii*); the criollo duck, a domesticated form of the Amazonian duck (*Cairina moschata*); and the suckling pig (*Dactilopius costae*) associated with the prickly pear crop.

It is estimated that approximately 65% of national agriculture depends on native genetic resources, among which are grains (quinua, *Chenopodium quinoa*, kiwicha, *Amarantus caudatus,* and cañiwa, *Chenopodium pallidicaule*) of great potential as a future source of food for humanity because of their high protein value; fruits; roots (yacón, *Smallanthus sonchifolia,* arracacha, *Arracacia xanthorriza,* and maca, *Lepidium meyenii),* Andean tubers, and legumes. An important part of the national livestock production depends on native genetic resources, especially camelids.

Instruments for biodiversity management

The Peruvian Political Constitution[3] declares that natural resources, renewable and non-renewable, are part of the national patrimony, the state promotes their sustainable use, and it is obligated to promote biodiversity conservation and protect natural areas[4].

The planning and management of biodiversity that includes genetic resources is regulated by the Convention on Biological Diversity (CDB)[5], the Regional Strategy for the Biodiversity for Tropical Andean Countries (ERBD)[6], the *Law of Conservation and Sustainable Use of the Biological Diversity*[7] and its regulations[8], and the National Strategy on Biological Diversity (ENDB)[9]. These are complemented by the *Law for Management and Sustainable Use of Medicinal Plants*[10], the *Mark Law for the National System of Environment*

[3] Ratified by Referendum October 31st, 1993.
[4] Articles 66, 67, and 68 of the Political Constitution of Peru.
[5] Approved in the Rio Summit in June 1992, ratified by Peru through a Legislative Resolution No. 26181.
[6] Decision No. 523, Lima - Peru, July 7th, 2002.
[7] Law No. 26839, January 17th, 1997. Its objectives are regulating the conservation of biological diversity and sustainable use of its components, and incorporate the principles and definitions of the CDB.
[8] Supreme Decree No. 068-2001-PCM, Publisher on July 21st, 2001 at the official newspaper El Peruano.
[9] Supreme Decree No. 102-2001-PCM, September 4th, 2001.
[10] Law No. 27300, promulgated on June 15th, 2000.

Management[11] and its regulations[12], the *General Law of the Environment*[13], and the *Law for the National Protected Areas*[14].

These instruments at the international, regional, and national levels recognize the sovereign rights of states over their natural resources and also the importance of their conservation and sustainable use. In Peru, they also define a ecosystem approach for managing biodiversity, prioritizing conservation aspects (ecosystems, species, and *in situ* and *ex situ* genetic resources), integrating sustainable use (genetic resources access, biosafety, etc), providing special measurements for conservation and restoration of biodiversity (control of invasive species, modified living organisms, etc), committing and participating in Peruvian society, and also promoting the investigation, assessment, protection, and strengthening of knowledge, innovations, traditional practices, and capacity building.

The Natural Protected Areas (ANP) are continental or marine areas of the national territory, dedicated to biodiversity conservation and other scientific-, cultural-, and scenic-related values; they constitute the national patrimony and are kept for perpetuity. Under state administration, they constitute the National System for the Natural Protected Areas (SINANPE), and are also under regional or local government administration and also private administration. Carrying out SINANPE management is delegated to the National Institute of Natural Resources (INRENA).

The National Program of Agro-Biodiversity[15] that prioritizes the conservation and sustainable use and participative management of agro-biodiversity, beginning from the identification, characterization, and valuation, and respect for local cultures, is actually in the process of being implemented by regional governments. The Technical Secretary of the Program is in charge of the Biodiversity and Biosafety Unit of the Environment Ministry (MINAM)[16] (formerly the National Environment Council).

In addition, the MINAM is now promoting the establishment of *ex situ* conservation centers of the Biological Diversity Network, that includes germplasm banks and conserved species for food and agriculture; and also possession and management centers that are

[11] Law No. 28245, promulgated on June 4th, 2004.
[12] Supreme No. 008-2005-PCM, promulgated January 28th, 2005.
[13] Law No. 28611, promulgated October 13th, 2005.
[14] Law No. 26834, promulgated June 17th, 1997.
[15] Decree of the Directive Council No. 022-2004-CONAM/CD, November 26th, 2004.
[16] Resolution of the Executive Secretary No. 004-2005-CONAM/SE, November 12th, 2005.

comprised of faunal centers (zoos, rescue centers, transit centers, zoo breeding centers, and museums) and floral centers (botanic gardens, nurseries, and herbariums).

Access to genetic resources

Access to genetic resources contained in biodiversity and derived products is regulated by the CBD, the International treaty for Plant Genetic Resources for Food and Agriculture of the United Nations Organization for Food and Agriculture (TIRFAA)[17], the common regimen of Common Access of the Genetic Resources[18], the *Forestry and Wild Fauna Law*[19] and its regulations[20], the Genetic Material Transfer Agreement that some *ex situ* conservation centers possess (International Potato Centre; CIP), and the National Institute of Agrarian Innovation (INIA)[21]. The INRENA also has developed some formats of Genetic Material Transfer Agreements for wild species and microorganisms, especially for scientific research.

These regulations define the sovereignty of countries over their genetic resources and derived products, and in consequence determine their access conditions. Access to genetic resources and activities of bioprospecting of biodiversity that involve wild floral and faunal species at *in situ* conditions are regulated by the *Forestry and Wild Fauna Law* and its regulations, and INRENA is the institution in charge until the regulation of the Common Regimen of Access to Genetic Resources is approved.

The regulation proposal[22] that stipulates that the Common Regimen of Access to Genetic Resources be effectively implemented is now at MINAM for promulgation. MINAM is in charge of the inter-sectorial coordination for environmental affairs including biological resources that encompass genetic resources, and the National Commission for Biological Diversity (CONADIB) is the multisectorial consultative agency responsible for policies on the conservation and sustainable use of biological resources.

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[17] Approved by Supreme Decree No. 012-2003-PCM, published at the official newspaper El Peruano, January 27th, 2003.

[18] Decision No. 391, Adopted in Caracas on July 2nd, 1996, based on the third transitory disposition of Decision 345 of the Commission and the proposal 284/rev.1 of the board, was published by the official gazette on July 17th, 1996.

[19] Law No. 27308, July 15th, 2000. The law defines that the forestal resources comprehend wild species of emerging terrestrial and aquatic flora as biological resources that contain genetic resources or their derivates.

[20] Supreme Decree No. 014-2001-AG, published by the official newspaper El Peruano on April 9th, 2001.

[21] Jefatural Resolution No. 117-2001-INIA, July 2nd, 2001

[22] Second proposal of Decision No. 391 Regulation, prepared by the National Commission of Biological Diversity-CONADIB.

The competent authorities in charge of the evaluation of the appropriateness of the applications and access projects are INRENA for genetic resources and natural molecules contained in continental wild species; INIA for genetic resources and molecules contained in cultivated and domestic continental species; and the Vice Ministry of Fisheries of the Production Ministry for genetic resources and molecules contained in continental and marine hydro-biological species.

Traditional knowledge protection

The regimen for the protection of the collective knowledge of indigenous people linked to biological resources[23] has established three types of registries: 1) confidential knowledge, 2) public domain knowledge, and 3) local registries (in charge of indigenous people), and the Direction of Inventions and New Technologies (DIN) from the National Institute of Competition Defence and Protection of Intellectual Property (INDECOPI) is the national competent authority. Nowadays, the National Public Registry (public domain knowledge) has more than 200 registries supported by at least one publication. Many indigenous communities are developing local registries.

Biosafety

Biotechnology and its rational management, especially the development of safe biotechnologies for biodiversity and the environment established in the 21st Agenda[24] and the CDB are regulated in Peru, and that is why our country has ratified the Protocol of Cartagen[25] on the safe use of biotechnology. At the Andean community (CAN) level, decisions such as the Common Regimen for Protection of the Breeder's Right of Plant Varieties[26], Common Regimen of Genetic Resource Access[27], and the ERBD contemplate the development of biotechnology and biosafety mechanisms.

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[23] Law No. 27811, published in the Official Newspaper El Peruano on August 10th, 2002.

[24] Program of United Nations (ONU) to promote the sustainable development of the community, in equilibrium with the natural capital and with the local economic capacities, approved at Rio de Janeiro Summit in June 1992.

[25] Legislative Resolution No. 28170, published at Official Newspaper El Peruano on February 15th, 2004.

[26] Decision No. 345, approved October 21st, 1993.

[27] Decision No. 391, approved July 2nd, 1996.

Thus, Peru has promulgated the *Law for Risk Prevention of Derived Uses of Biotechnology*[28] and its regulations[29], and is in the process of implementing Competent Sectorial Organisms. This ruling regulates different activities with modified living organisms (OVMs), at different stages from the research level, production, introduction to commercialization, and confined use, and liberation under controlled conditions. In addition, it defines the institutional design for a biosafety legal mark supported by three pillars: competent distribution among the sectorial organisms, conformation of a technical advisory committee, and their coordinated performance through an intersectorial organism, the MINAM.

The OSC includes the INIA, Fishery Vice-ministry of the Production Ministry, and the General Direction of Environmental Health (DIGESA) of the Health Ministry, for agriculture, fishery, and health sectors, respectively. INIA has incorporated this mandate in its Organization and Functioning Regulation (ROF)[30] and has created its Biosafety Intern Committee (CinBio)[31] and approved CinBio's ROF[32].

The legislative decree that regulates the Agrarian Innovation National System[33] granted INIA the authority to sanction, in the scope of its competence, typify, and qualify infractions included in the biosafety sectorial regulation proposal that is in the approval process.

Conservation of biodiversity

SINANPE is the most important system for the *in situ* conservation of biodiversity in Peru. Nowadays, it encompasses 63 natural protected areas that represent almost 14.8% of the total country surface, placing Peru among Latin American countries with a higher percentage of territories conserved under this modality (19,041,079 ha). SINANPE includes categories such as, national parks, national sanctuaries, historic sanctuaries, national reserves, wildlife refuges, landscape reserves, communal reserves, protected forests, game preserves, reserved zones, and also regional and private conservation areas.

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[28] Law No. 27104, promulgated on May 7th, 1999.
[29] Supreme Decree No. 108-2002-PCM, promulgated on October 21st, 2002.
[30] Supreme Decree No. 031-2005-AG, July 13th, 2005.
[31] Jefatural Resolution No. 00124-200/-INIA, May 08th, 2008.
[32] Jefatural Resolution No. 00232-2007-INIA, September 21st, 2007.
[33] Legislative Decree No. 1060, published at Official Newspaper El Peruano on June 28th, 2008.

Conservation of genetic resources for food and agriculture

Ex situ conservation

In Peru, germplasm banks of plant and animal genetic resources are mainly distributed among research institutes, universities, and NGOs. Gutierrez and Sigüeñas (2002) reported that 22 institutions have germplasm banks, of which 11 are public and 11 private. Among private institutions, five are from NGOs. They are preserving 54,351 accessions representing 255 species. Among these, 62.4% have passport data, 63.9% have morphological data, and 48.8% have agronomic data such as performance, tolerance to stress, and resistance to pests and/or diseases of the total accessions. They carry out short- and medium-term conservation, with the exception of the IPC, which conducts long-term preservation through cryopreservation.

The INIA through the SUDIRGEB is officially responsible for the conservation and sustainable use of genetic resources of agro-biodiversity and for enhancing its value, either as food security or as source of genetic resources for breeding programs. Conservation is carried out through a network of ten Agricultural Experimental Stations that mainly preserve genetic material from native crops.

The SUDIRGEB-INIA owns the largest germplasm bank of the country, comprising 30 national collections categorized as crops or crop groups, which preserve 17,147 accessions from 201 species in three forms: in the field, *in vitro*, and in cold rooms. The IPC maintains 16,958 accessions for crops such as potatoes, sweet potatoes, and other Andean roots and tubers, and the La Molina Agrarian National University (UNALM) preserve 3023 accessions of maize. In terms of the conservation of native species of medicinal plants, the Research Institute of the Peruvian Amazon (IIAP) reported owning a Botanical Garden of Medicinal Plants in its Biological Station Allpahuayo in Iquitos (Table 1).

In addition, a seed bank of forest species was reported, which is responsible to the National Project for Watershed Management and Soil Conservation (PRONAMACHCS).

Table 1. Institutions that have *ex situ* germplasm banks of plant genetic resources

Institution	Sector	Region	No. of accessions
National Institute of Agricultural Innovation (INIA)	Public		
Subdirection of Genetic Resources and Biotechnology (SUDIRGEB)			
– Headquarters		Lima	2166
– EEA Andenes		Cusco	3115
– EEA Baños del Inca		Cajamarca	2220
– EEA Canaán		Ayacucho	1912
– EEA Donoso		Lima	1566
– EEA El Porvenir		San Martín	338
– EEA Illpa		Puno	3738
– EEA Pucallpa		Ucayali	125
– EEA San Roque		Loreto	196
– EEA Santa Ana		Junín	1771
National Program of Research in Corn and Rice (PNIMA)			
– EEA Vista Florida		Lambayeque	196
– EEA El Porvenir		San Martín	2213
National Program of Research in Fruits (PNIF)			
– EEA Baños del Inca		Cajamarca	47
– EEA Santa Ana		Junín	40
– EEA Pucallpa		Ucayali	100
National Program of Research in Tropical Crops (PNICT)		San Martín	48
National Program of Research in Pasture and Forage (PNIPF**)**			
– EEA Baños del Inca		Cajamarca	20
– EEA El Porvenir		San Martín	125
National Program of Research in Andean Crops (PNICA)			
– EEA Canaán		Ayacucho	957
– EEA Santa Ana		Junín	1841
National Program of Research in Potato and Sweet Potato (PNIPC)			
– EEA Santa Ana		Junín	666

Research Institute of the Peruvian Amazon (IIAP)	Public		
– CRI-IIAP-San Martín		Tarapoto	18
– Promising Native Fruit Project, Medicinal Plants and Biocides		Iquitos	59
– Palmeras Project and Plant Genetic Resources			120
Universities			
Pedro Ruiz Gallo National University	Public	Lambayeque	64
Jose Faustino Sanchez Carrion National University	Public		
– Institute of Research in Agricultural Sciences		Lima	69
La Molina Agrarian National University	Public		
– Cooperative Program of Research in Corn (PCIM)		Lima.	3023
– Program of Research in Legumes		Lima.	445
National University of Central Peru	Public		
– Program of Research in Legumes		Junín	1244
– Program of Research in Andean Crops		Junín	340
– Program of Research in Andean Roots and Tubers		Junín	1105
– Program of Research in Cereals		Junín	108
San Antonio De Abad Del Cusco National University	Public		
– Center of Research in Andean Crops (CICA) – Program of Quinua and Kiwicha		Cusco	2000
Institution	**Sector**	**Region**	**No. of accessions**
National University of the Peruvian Amazon	Public		
– Faculty of Agronomy		Loreto	703
National University of Sanmartin	Public		
– Faculty of Agricultural Sciences		San Martín	127
– Department Agro-Silvopastoril		San Martín	82
Agrarian National University of Amazon	Public		
Germplasm Bank of Cocoa – Faculty of Agronomy		Huánuco	160
National University of Ucayali			
– Agricultural Academic Department	Public	Ucayali	69
International Center			
International Center for Research in Agroforestery (ICRAF)	Public	Ucayali	822
International Potato Center (CIP)	Private	Lima	16,958

Others			
Program for Promotion of the Exports (**Prompex)** – Legumes Project – PROMENESTRAS	Private	Lambayeque	162
Institute of Agrarian Development Lambayeque (IDAL) – Carob Project	Private	Lambayeque	3
Educational Services of Promotion and Rural Support (**SEPAR)**	NGO	Junín	198
Regional Institute for the Education and Development (REDES) – Program of Andean Crops	NGO	Junín	229
Andean Rural School (ERA)	NGO	Cajamarca	308
REGIONAL CENTER OF RESEARCH IN ANDEAN BIODIVERSITY (CRIBA)	NGO	Cusco	1221
NURSERY THE CACTUS	Private	San Martín	13
ANDEAN AMAZON RURAL ASSOCIATION (ARAA) CHOBA (CHOBA)	NGO	San Martín	196
CIVIL PARTNERSHIP MARAY	Private	San Martín	20
Total			53,327

Source: Modified from Gutiérrez and Sigüeñas (2002).

Most germplasm banks do not have the right conditions for long-term conservation of plant genetic resources. Simple constructions (brick and/or mud), and no control of temperature or humidity are predominant. Approximately, 50% of collections are kept in cold rooms at temperatures ranging from 2 to 4 °C and 40% to 80% relative humidity, for periods ranging from 5 to 10 years; the containers used are aluminum bags, glass, or plastic jars and tin containers. Some institutions such as the IPC, UNALM, and SUDIRGEB have cold rooms for the conservation of germplasm. However, an evaluation of the space and equipment capacities of germplasm banks needs to be conducted to ensure the proper conservation of national plant genetic resources.

The *in vitro* conservation of germplasm is also used as a conservation strategy. With this method, the INIA maintains collections of oca, olluco, mashua, yacon, cat's claw, cinchona, and passifloras; and, the CIP maintains 11,382 accessions for potatoes, sweet potatoes, and other Andean roots and tubers.

In relation to the conservation of animal genetic resources, there are *in situ* germplasm banks of alpacas and llamas, located at the Experimental Center of Quimsachata of the INIA in Puno. In addition, there are representative collections with samples of ecotypes of guinea pigs, which are maintained by the INIA, for research and breeding. On the other hand, the SAIS Tupac Amaru maintains the genetic nucleus of the Junin sheep breed.

The UNALM, through its Animal Breeding Program, has under its administration the National Bank of Semen, where the semen of national bulls of Holstein and Brown Swiss breeds used for livestock improvement is cryopreserved.

Despite all these efforts, conservation programs for animal genetic resources need to be implemented by including *in situ* and *ex situ* strategies for native species such as the guinea pig, creole duck, and adapted species mainly from landraces of cattle, sheep, pigs, chickens, and goats.

In situ conservation

In situ conservation of plant genetic resources in our country has been practiced since ancestral times by local farmers, especially in the Andean region. Since the 1990s, there have been many *in situ* conservation projects executed. Tapia (1998) stated that between the years 1993 and 1995, it developed a project with the aim of studying the dynamics of *in situ* conservation and establishing microgenocenters (centers of diversity) of biodiversity of Andean tubers. In addition, he noted that the Livestock Agro-Forestry Service (SESA) has registered traditional varieties of roots and tubers and has provided support for conservation in the communities of the microbasin of the rivers Jequetepeque and Cajamarca, in the Cajamarca region. In addition, the NGO, Jorge Basadre, has supported peasant organizations called ronderos to conserve their genetic material in the Chota and Cajamarca regions.

The same author, reported that the NGO, Aspaderuc, supported by the Consortium for Sustainable Development of the Andean Ecoregion (CONDESAN), has developed a project to support *in situ* conservation carried out by the peasants of the Encañada district of the Cajamarca region. They have developed a database of 254 peasants who took part in 10 seed trade fairs, which belong to 98 hamlets in the towns of Encañada, Namora, and Sorochuco, and also have registered a detailed record of more than 500 entries from tubers, grains, vegetables, fruits, and forest products.

On the other hand, an *in situ* conservation project of Andean roots and tubers was reported by the Program of Genetic Resources and Biotechnology (PRONIRGEB) of INIA (now SUDIRGEB), in the communities of Chugurmayo, La Florida, and La Victoria, in the region of Cajamarca.

From 2001 to 2006, the *in situ* Conservation Projects of Native Crops and Their Wild Relatives have been executed involving six institutions: the (ARARIWA), the Coordinator of Science and Technology in the Andes (CCTA), the Agricultural Services Center (CESA), the Research Institute of the Peruvian Amazon (IIAP), the INIA, and the Andean Project of Peasant Technology (PRATEC). The long-term goal of this project was the conservation of biodiversity in Peru, and 11 species of crops were prioritized, including several local varieties and wild relatives. It was carried out in 53 districts, which included 154 communities in 12 regions of the country. Its main activities are the conservation of biodiversity on farms, the protection of wild relatives of crops, the inventory of conservationists farms and crop varieties, the strengthening of farmers' organizations, the development of policies to support *in situ* conservation, the consolidation and development of markets for prioritized species, and the development of an information system and monitoring as an important tool for planning and coordinating conservation *in situ*.

The International Potato Center (IPC), is running *in situ* conservation projects for the crops of potatoes, sweet potatoes, and other Andean roots and tubers, in collaboration with institutions such as the INIA, the Regional Center for Andean Biodiversity Research (CRIBA)-Cuzco, the National University of Cajamarca, the Aymara Community, the UNALM, the INRENA, the Research Center of Natural Resources and Environment (CIRNMA)-Puno, and the Association for Nature and Sustainable Development (ANDES)-Cusco. The CCTA is implementing a project of *in situ* conservation in communities of the region of Huanuco, in the highlands of Peru.

In addition, since 2000, the peasant communities of Chawaytiri, Sacaca, Paru Paru, Amaru, Pampallacta, and Cuyo Grande of the district of Pisac in the Cuzco region and the Association ANDES have partnered to promote a "Potato Park". This project aims to establish a geographic area to manage their resources, including the components of the DBA, taking as a premise the valuation of local culture in the management of their resources.

The INIA through the SUDIRGEB and the Peruvian Society for Environmental Law (SPDA), in conjunction with regional governments are promoting the establishment of "agro-biodiversity zones" which are geographic areas that have high diversity and many

varieties, and knowledge associated with the management and use of these resources. These areas will prioritize the conservation and sustainable use of biodiversity by organized communities.

Documenting and systemizing genetic resources

The MINAM has developed an environmental search engine called SINIA, which allows users to search for websites of institutions related to environmental matters and biodiversity. It also examined existing information systems in the country, and has drawn up a proposal of the Information System on Biological Diversity (SINIDIB).

There is a network of Peruvian Agricultural Libraries (REBIAPE), with the National Agricultural Library (UNALM) as the focal point. In this network, there are nine associated university libraries, two documentation centers of non-governmental institutions, and the General Direction of Agricultural Information of the Ministry of Agriculture, and also other institutions that have libraries and documentation centers on topics related to agro-biodiversity.

The National Agricultural Library, the library of the IPC, and the INIA's library store a large quantity of documents related to agro-biodiversity. In addition, they edit book summaries and compact discs, and also provide search services for different national and international databases. The IIAP and the *in situ* conservation project of native crops and their wild relatives have established a library on agro-biodiversity.

Other non-governmental institutions, such as the PRATEC, the Center for Research, Education and Development (ICDE), the Center for Studies and Promotion of Development (DESCO), the Action Network Alternatives for Agrochemical Use (RAAA), and the SPDA, have documentation centers and bibliographic information services on watershed management, conservation of native crops in general, and on agro-biodiversity. The CCTA has established a Center of Information Technology (CENITEC), which operates in Lima as feeders of information to a network of local Centers for Information Technology (CINTEL) Network, which reaches its NGO partners.

Regarding information on genetic resources, the SUDIRGEB of the INIA has developed an information system using the Linux platform and free software (PHP and MySQL) for information management of its germplasm bank, which will be available on a website. The system is currently in the test phase. In addition, the INIA has been included as the Peruvian

institution where the information system of the genetic resources of Global Green will be implemented; this system is being developed by Biodiversity International and the United States Department of Agriculture (USDA) with support from the Global Crop Diversity Trust.

The *in situ* conservation project of native crops and their wild relatives has developed an information system for monitoring the *in situ* conservation; its central node is the MINAM, and the sub-nodes are being installed in institutions and organizations that participated in its execution, NGOs, and other stakeholders.

Capacity building for developing and implementing management systems of genetic resources for food and agriculture

Capacity building for the management of genetic resources involves many subjects, including policies, legislation, conservation, training, and information systems. Policies and legislation are favorable for the development and implementation of systems for managing genetic resources for food and agriculture. There are management tools, such as international conventions and treaties, regional decisions and strategies, and national strategies, laws, and programs. However, policy makers do not always recognize and properly value genetic resources, and it is necessary to complement the legal framework with the approval of the Rules of the Common Regime on Access to Genetic Resources, the sectorial rules on security of the use of biotechnology, and recognition of "agro-biodiversity areas".

Important experience was gained through the *in situ* conservation project of crop farmers and native communities, where the local organizations were strengthened, and farmers were trained in the production, processing, and marketing of their products in order to give them added value and insert them into the market.

In terms of education, many initiatives have been implemented as pilot projects, seeking to incorporate environmental issues, biodiversity, native crops, the importance of their conservation, and their nutritional value in teaching programs at the school level. Universities offer a variety of careers related to the management and conservation of genetic resources, such as biology, agronomy, livestock husbandry, forestry, and agricultural engineering. However, there are only a few related courses on sustainable use and conservation of genetic resources. At the postgraduate level, the UNALM offers a master's of Applied Ecology, Plant Genetic Improvement, and Animal Production. From 2004 to 2006, the

National Agrarian University of the Amazon (UNAS) and the Andean Project for Peasant Technology (PRATEC) implemented a master's degree in Biodiversity and Agriculture Andean-Amazon, but it was discontinued in 2007.

In addition to university studies, a realization of the thesis work in various areas related to the genetic resources has helped train young professionals and technicians, although most of them out of job in the subject of their specialization. Also, there are no specializations or refresher courses in the country for those responsible for germplasm banks.

Information systems and databases on genetic resources are still emerging; we need to strengthen such activities in order to establish a system of information on the management of genetic resources for food and agriculture at a national level and not just rely on isolated institutional efforts, which is the situation so far.

In Peru, there are various institutions and organizations that are developing activities related to genetic resources for food and agriculture, from those responsible for the coordination (MINAM), to technical institutions responsible for the conservation of these resources. These institutions, in a coordinated manner have contributed to the development of management tools for genetic resources. In addition, private institutions, such as the CIP and NGOs have developed activities on *ex situ* conservation in germplasm banks.

In this country, germplasm banks of plant and animal genetic resources exist, but in most cases do not have adequate conditions to conserve these resources in the long-term, so it is necessary to develop capabilities for long-term conservation (cryopreservation). In addition, conservation programs for animal genetic resources need to be established which encompass *in situ* and *ex situ* strategies, as well as microorganisms, and continue strengthening local organizations that conserve genetic resources *in situ* (i.e., on farms).